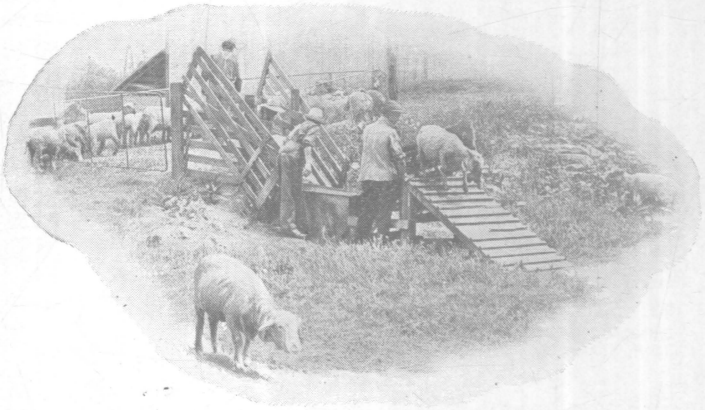
SOME PESTS OF OHIO SHEEP

OHIO

Agricultural Experiment Station

WOOSTER, OHIO, U. S. A., FEBRUARY, 1922

BULLETIN 356



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[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
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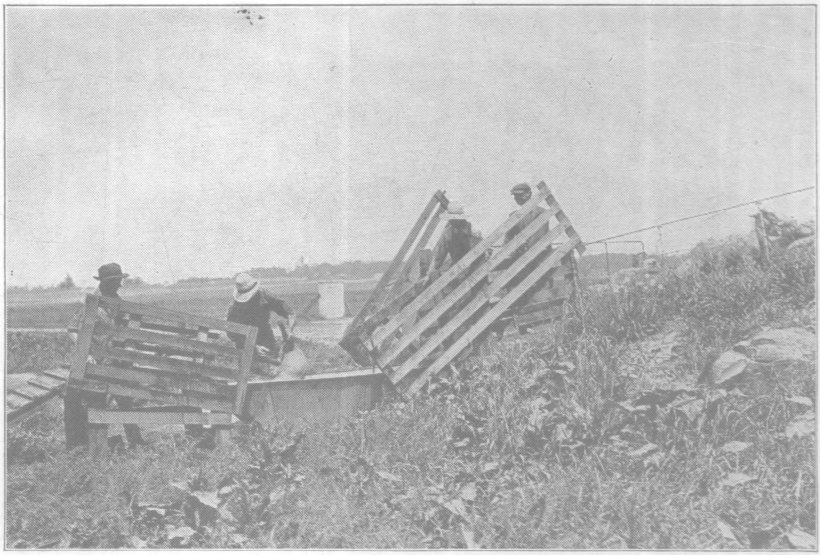
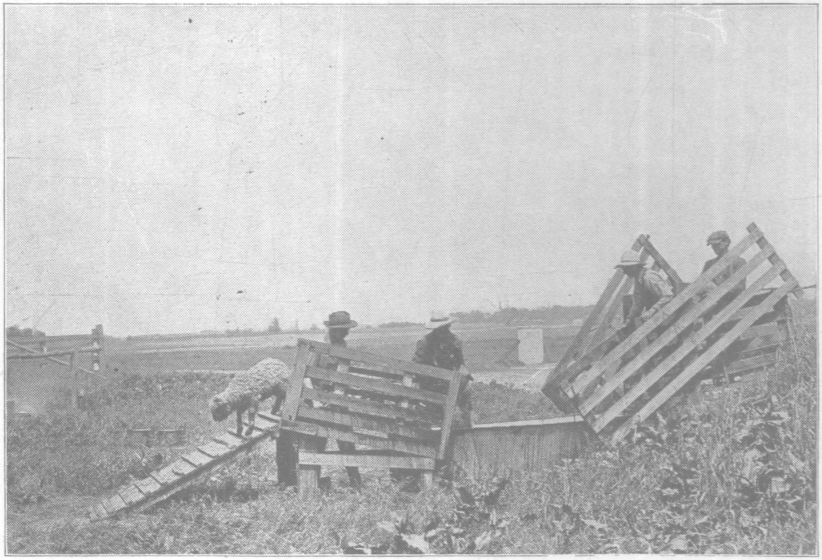
CONTENTS



Immersing the animal completely is necessary to control external parasites; sheep may be dipped readily with the equipment shown.



Animal leaving the dipping tank

BULLETIN
OF THE
Ohio Agricultural Experiment Station
NUMBER 356 FEBRUARY, 1922

SOME PESTS OF OHIO SHEEP

DON C. MOTE

SHEEP BOT FLY

Symptoms.—The action of sheep when attacked by the bot fly is familiar to every farmer and flockmaster. At the appearance of the fly, the sheep shake their heads and strike the ground violently with their fore feet. Lowering their noses to the ground, they run away from the spot in an attempt to shake off or dodge the fly. During the heat of the day, the sheep may crowd together with their noses held close to the ground or close under each other in an endeavor apparently to prevent the fly from striking them upon the nose.

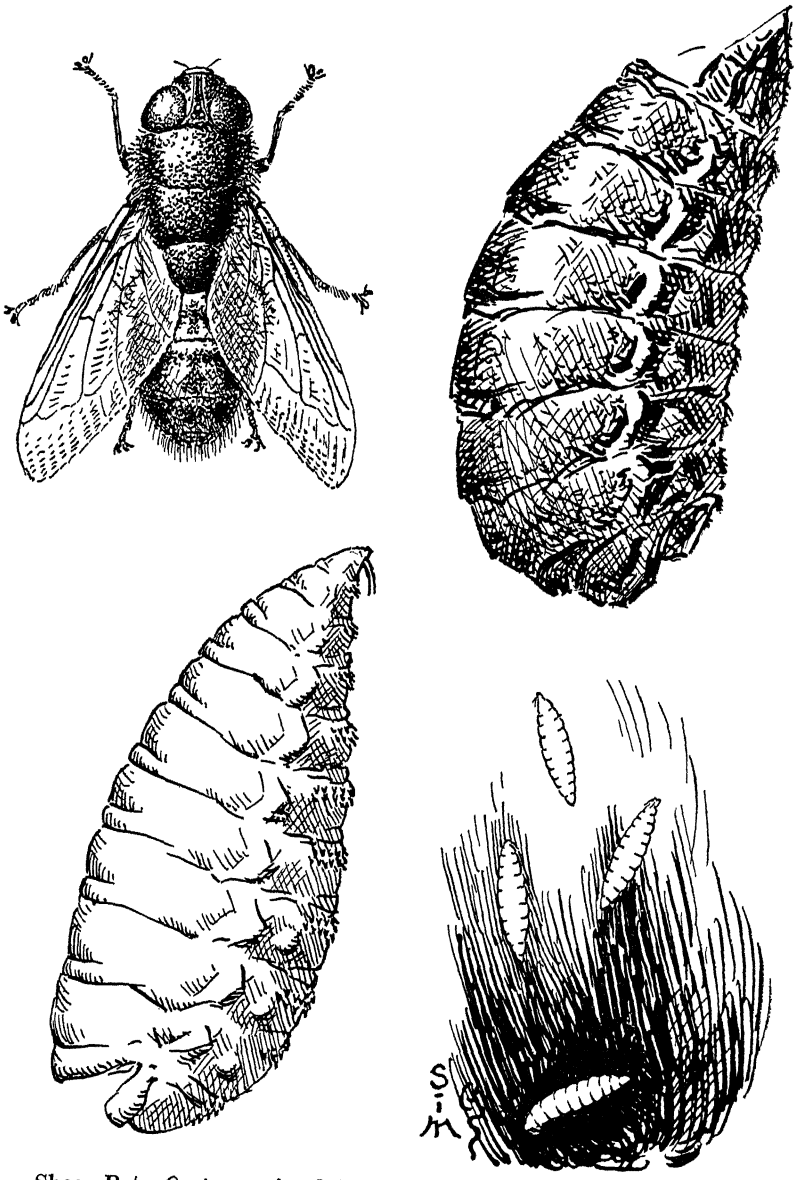
Description of Insect.—The adult fly is said to look something like an overgrown house fly. Although larger than the house fly, it is very difficult to see, and still more difficult to catch when flying. Notes on the life history of this fly and its habits in Ohio are not complete. However, the Ohio Station has in its parasite collection specimens of grubs in various stages of development, which throw some light upon this subject.

Minute larvae measuring one-sixteenth and five-sixteenths of an inch in length were found in the nasal cavities of sheep on September 26, 1916, at Wooster. Larvae of about the same size were found crawling up the nasal passages of sheep examined at Carpenter, Ohio, on November 6, 1916. From the size of these specimens it may be inferred that the fly is prevalent and depositing eggs or living larvae in late summer.

The minute larvae crawl up the nasal passages to the frontal sinuses—cavities located between two plates of the skull and lying

State Entomologist, Phoenix, Arizona Formerly Parasitologist, Ohio Experiment Station

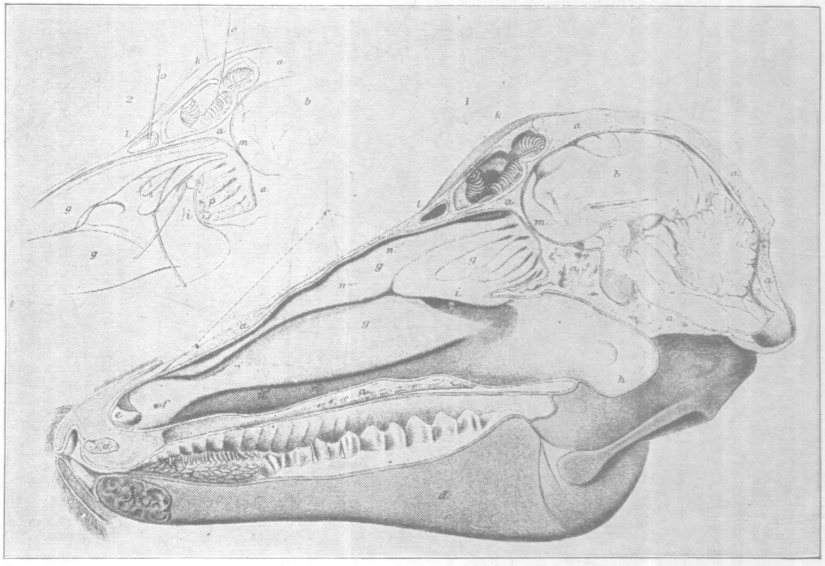
one on each side of the median line of the head, between and a little above the eyes. The frontal sinuses communicate with the nasal passages but are separated from the brain by a thick, bony plate. Here the larvae live through the winter, feeding upon the abundant mucus found there. In the spring, about shearing time or later,



Sheep Bot—*Oestrus ovis* adult, larvae, puparium and young larvae

the larvae crawl down the nasal passages and fall to the ground where they pupate. We have in the parasite collection nearly mature larvae collected on March 3 and on April 15. The former specimens were found in the cavity of the horn and probably would have matured the latter part of April The latter specimen probably would have matured in May.

We have only one note on the length of the pupal stage, which, however, is incomplete. On March 29, 1918, five bot-fly pupae were received from Carpenter. When found, in the manger of a sheep pen, they were in the larval stage. The transformation from the larval to the pupal stage took place during transit from Carpenter to Wooster, or within a period of 3 days.

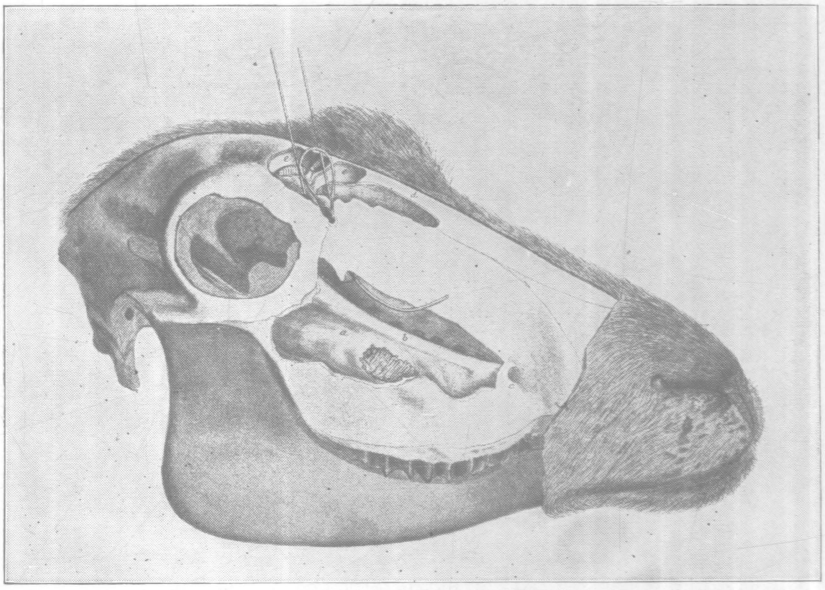


Sinuses of sheep's head invaded by Oestrus larvae. From Bureau of Animal Industry, U. S. D. A.

Upon receipt the pupae were placed in an insect-rearing cage. On May 23 or 55 days later, the soil over the pupae was removed. Two of the puparіums were empty. Evidently two flies had emerged. A search revealed a male and female in the folds of cloth covering the hole in one side of the cage. Frequent observation of the cage failed to display an adult fly, so it was assumed that none had emerged. How long since these two had emerged is of course not known. The flies were dead when found. No flies ever emerged from the remaining pupal cases. According to various authorities the length of the pupal stage varies from 40 to 50 days,

depending upon the temperature. Assuming that the grubs mature in April, then the flies would be present during May and perhaps June and July. But it is not likely that all the grubs mature at the same time, so the flies are probably present during May, June, July and August, and possibly later. Since we have in the parasite collection only two specimens of the adult flies, reared from the grub stage, a statement of the seasonal appearance of the fly in Ohio cannot be definitely made.

Control.—While the life stages of this pest have long been described, its habits and relative abundance under different methods of flock management still remain subjects for investigation. New and adequate methods of combating the sheep bot fly may result from information thus obtained.



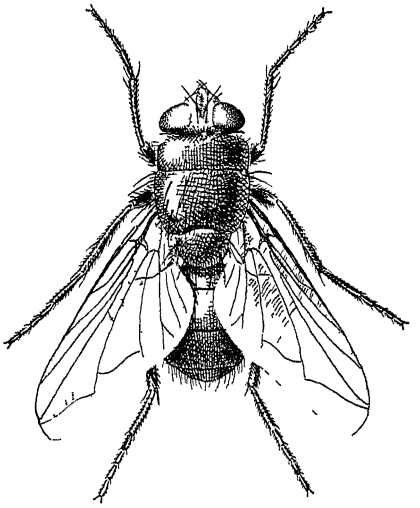
Sinuses of sheep's head invaded by Oestrus larvae
From Bureau of Animal Industry, U. S. D. A.

Remedies now commonly recommended consist of the application of some repellent, such as tar, to the sheep's nose to keep the flies away and trephining to remove the grubs in case they become injurious to valuable sheep.

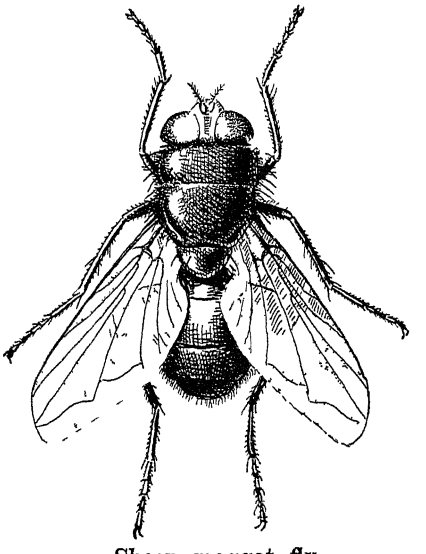
SHEEP MAGGOTS

Symptoms and Injury.—The maggots usually attack the flesh in the region of the rump or the horns. They have hatched from eggs deposited by flies attracted to the wool soiled with urine or

scourings, or with blood from slight cuts or bruises around the horns caused by fighting. If neglected, the infestation continues, additional flies depositing their eggs upon the wool that has been rendered more attractive by its vile odor. The maggots, working in the wool next to the skin, some even in the flesh, soon loosen large patches of the wool. These patches may be easily removed or they may even slough off, exposing a red, raw maggot-infested flesh. Healthy tissue is soon invaded by the maggots and death may follow, usually from some form of blood poisoning, if the infestation is not checked immediately. Even if the animal's life is saved, considerable loss of flesh and wool usually occurs. The old adage "An ounce of prevention is worth a pound of cure" is certainly applicable in combating this pest.



Sheep maggot fly
Phormia regina



Sheep maggot fly
Lucilia sericata

The Insects.—Two species of flies have been bred by the Ohio Experiment Station from maggots infesting the wool of sheep. Both are related through family ties to the house or typhoid fly. A brief description and life history of each species, that has been identified on live wool, follow.

GREEN BOTTLE FLY

Lucilia sericata Meigen

This bright greenish-tinted fly is the well-known sheep maggot-fly of the British Isles. There it is popularly known as the

"blue bottle" although it has more bright greenish tints than any other tint. Like the house fly, it is rather closely associated with the habitations of man. These bright-colored flies are often very noticeable in cities, feasting upon garbage, decaying vegetable or animal matter. They may also come into the house and blow exposed meat.

The fly is of moderate size and is of a rich metallic green color with bronzy tints on the abdomen. It differs from other species of the genus *Lucilia* in having the center of the dorsal surface of the meso-thorax furnished with three pairs of stout bristles, and bristles on the third abdominal segment rather small and hidden by long silken hairs. The front of the thorax behind the head is covered with a fine whitish bloom. These flies are distinguished from the common blow flies *Calliphora* by their smaller size, rich metallic tints and whitish bloom on the thorax behind the head. The space in front of the head, which in the typical blow fly is covered with fine hairs, is bare.

The female fly, attracted by foul smelling wool, deposits its eggs in clusters of a few dozen to one hundred or more. The eggs, stuck together with a secretion that adheres to the wool, are pale yellow and about one-sixteenth of an inch long. The life history of this species has been carefully observed from the stage when the eggs were found upon the wool to that of the adult fly. Eggs laid sometime between 10 A. M. and 3 P. M. on September 21, 1916, were collected and placed in vials. The eggs in the different vials hatched in 9, 17 and 24 hours. Those hatching first were kept at a warmer temperature (26 degrees) C. Of three vials kept at the same temperature, the eggs in one hatched in 17 hours and those of the remaining two began hatching in 24 hours.

The maggots were fed upon meat and in 6 days were mature and ready to pupate; in 7 days after pupation the perfect fly emerged (temperature ranging from 22 to 30 degrees C). The fly thus averages a life cycle of about 14 days in warm weather.

The maggot (larva) is smooth and cylindrical, tapering toward the head end, becoming thicker toward the anal end. The head is provided with a pair of black, sickle-shaped hooks with which the maggot digs into the flesh. Some of the rear segments are furnished on the underside with rows of very fine spines which aid the larva in moving. It moves along rapidly in its food material, in the wool, or on the ground. When mature the larva generally drops to the ground and contracts into a form somewhat the shape of a barrel, called the pupa. The skin of the larva becomes the pupa-case,

hardens and assumes a dark brown tint. On the inside of this pupa-case wonderful changes take place, resulting in a perfect fly.

This fly probably winters over in the pupa-case, since pupae were found in the pen, which contained a fly-blown sheep, underneath the bedding in late October. Larvae placed in an outside cage in late fall were found in the pupa stage in the early spring. On May 18, 1917, two adult flies were taken from this cage and one plump pupa was found. Later, June 13, an adult fly emerged from this pupa-case. On June 17, four adults flies were taken from the cage. These flies lived until June 22 (5 days) without food or water.

BLACK BLOW FLY

Phormia regina Meigen

The black blow fly has been reared from larvae working in blood-stained wool around the horns of rams pasturing together. Thus this fly differs from the "blue bottle" in that it is attracted to and deposits its eggs in wool, stained from bruises or minor skin injuries. The eggs, according to F. C. Bishopp (Farmers' Bulletin No. 857) hatch in from less than 24 hours to 4 days. From a collection of larvae received from Carpenter, Ohio, July 24, 1918, pupae were formed 5, 7 and 8 days later. Adult flies emerged from the pupal cases 9 days later. Of another collection received August 21, 1916, the pupal stage lasted from 7 to 8 days. Summarized, the length of time from egg to fly may range from 13 to 21 days. The adult fly is considerably larger than the house fly and greenish black in color. It is very prolific and usually becomes very abundant during the late summer.

Control.—Careful examination at intervals of a few days of each member of the flock during the summer and early fall months is recommended. Soiled wool likely to attract the flies may be removed or treated with some deodorant in order to counteract the smell that attracts the flies. If sheep are blown, the infested wool should be sheared off, all the maggots removed and killed and the infested area rubbed with a crystal of blue stone (copper sulphate). The Ohio Station has found the copper sulphate treatment very effective if used in the early stages of the infestation. It dries the infested area and stops the decomposition which gives rise to the putrid smell that attracts the flies. Reinfestation is thus prevented. Crutching is recommended and used in Australia as a blow fly preventive.

Sheep infested over a larger area are not so easily cured. The infested wool and all the maggots should be removed. To remove

the maggots tunnelling under the skin, the application of chloroform to the infested parts, is recommended. Then the area should be dressed with some mixture that will repel the flies. A mixture consisting of crude carbolic acid, 1 part; kerosene, 3 parts; fish oil, 4 parts; and oil of tar, 2 parts, was found to be effective.

To reduce the chance of maggot-fly attacks measures designed to reduce the number of flies should be adopted. These measures include the destruction of all matter in which the maggots may develop, such as dead carcasses, entrails, pieces of meat and in fact every kind of animal offal. Build a firewood heap and then place the carcass or offal on the heap and see that all the material is consumed. Partially-burned animal flesh may harbor millions of maggots. Another measure to be recommended when the flies are abundant, consists in half skinning an animal which has recently died and cutting the flesh. Then pour over this carcass a solution of 1 pound of arsenic dissolved by boiling in 5 gallons of water, and this carcass will attract hundreds of flies which on sucking the poison die off in great numbers. This method of poisoning adult flies has been used in Australia with the result that thousands of flies die around every carcass thus treated (Farmers' Bulletin 95 by W. W. Frogratt, Government Entomologist, New South Wales).

The action of the arsenic upon the flesh, however, soon stops the decomposition and hardens it, so that it loses its attractive power within the second day; but the carcass can be turned over and the under surface will act as a poison bait for another day if similarly treated. The carcass should then be burned or buried.

SHEEP TICK

Melophagus ovinus Linn.

Injury.—This parasite lives upon the blood of sheep which it obtains by sinking its sucking tube into the flesh. Although one tick may not consume much blood in 24 hours, the total amount taken by a large number of ticks constitutes a serious drain upon the infested animal. The irritation caused by the ticks makes the sheep restless. It stamps its feet, scratches the irritated spot with its hind foot, bites at it or rubs against the manger, a post or any other object within reach. This continual scratching and rubbing brings about a ragged, taggy appearance of the coat of wool. The infested sheep does not thrive well, growing or fattening slowly.

During the winter of 1918-19 the Ohio Station conducted a feeding experiment with two lots of lambs, some of which as the winter progressed became heavily infested with ticks and lice.

The lambs were weighed individually each week so that a comparison of gains made could be readily ascertained. It was easy also to determine the relative number of ticks and lice infesting each sheep. It was found that the lambs heavily infested were the ones that did not gain. Table I shows changes in weight during 1 week as well as the degree of infestation at the time. It will be noted that sheep numbers 190 and 226, having but few lice and no ticks, made gains during the week while the others either remained nearly the same or lost in weight. Of course it would be difficult to determine from these data the exact role played by ticks and lice separately in reducing the weight. Both parasites finally became so abundant as to interfere with the object of the experiment.

TABLE I.—COMPARISON OF LOSS OR GAIN IN WEIGHT AND DEGREE OF INFESTATION WITH LICE AND TICKS

Lot 1				
Sheep number	Weight in pounds		Degree of infestation	
	February 9	February 16	Lice	Ticks
190	81.5	83.5	Very few	0
226	46	47	Very few	0
185	78.5	78	Fairly heavy	Fairly heavy
191	95	94.5	Fairly heavy	Fairly heavy
209	61	60	Fairly heavy	Fairly heavy
222	75	75.5	Fairly heavy	Fairly heavy
186	74.5	75	Fairly heavy	Fairly heavy

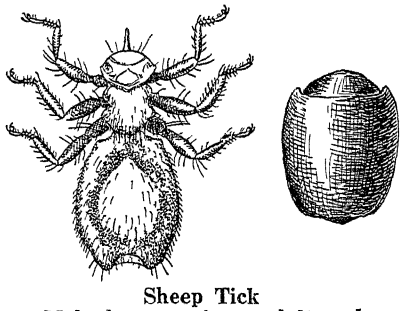
"Heavy infestation" as used in the table, means that one had no difficulty in finding ticks or lice on any part of the animal. From the foregoing it is evident that the sheep tick causes a shrinkage in weight, and unthrifty condition of the infested animal and a ragged, taggy coat of wool. The vitality of the animal is also much reduced so that it cannot offer normal resistance to the attacks of other parasites or diseases.

The tick.—The sheep tick is, according to entomologists, a wingless fly, hence it is in no way directly related to the true ticks. A true tick has in the adult stage eight legs, while the so-called sheep tick has only six legs and in general form and structure is quite different.

The life cycle of the tick is unlike that of most of its kin, the flies. The egg and larva develop within the female which finally deposits her offspring in the pupal stage. The pupa is a hard shelled, seed-like body, at first a pale color, later turning brown. On the inside of the shell changes are in progress which in time result in a young tick, which breaks open the shell at one end and

emerges eager for a meal of blood. The time between the depositing of the pupa and the emergence of the young tick varies, depending upon the temperature in part at least. This time has been variously estimated at from 10 to 19 days in summer and 24 days or even longer in winter. Young ticks have been observed to emerge from pupae on the host animal 19 days after the pupae were deposited. When taken off the host animal and kept in vials young ticks have emerged in 20, 25, 27 and 29 days after the pupae were collected. The temperature during this time ranged from 65 degrees to 80 degrees. The young tick develops very rapidly reaching sexual maturity in a few days. The female deposits her first pupa about 14 days after emerging from the puparium which the hard shell is called.

The longevity of the young and adult ticks is of practical interest, since this point will determine how soon it will be safe to turn sheep dipped for ticks into pens or pastures formerly occupied by infested sheep. Young ticks have been observed to live for 5 days away from sheep, while adults have lived from 4 to 7 days. Those ticks recently engorged with blood generally live longer when removed from sheep than those not so engorged.



Sheep Tick
Melophagus ovinus, **adult and puparium**

The ticks spread from one sheep to another through contact both with infested sheep or with tags of wool from infested sheep. During cold weather when sheep are placed in sheds in close contact the conditions are favorable for a rapid spread of the ticks. They pass readily from one sheep to another, especially from the ewe to her lamb.

Control.—The points of practical interest then in the life history and habits of the tick bearing on its control are:—(1) length of pupal stage, generally 19 to 24 days; (2) period before female deposits her first puparium, about 14 days; (3) longevity of tick when removed from host, 4 to 7 days; the pupae of course when removed would hatch out in 19 to 24 days or even longer into ticks capable of reinfesting animals; (4) the ticks pass readily from infested animals to other animals. There is even danger of the attendants spreading them. Ticks have been found upon the trousers of attendants several hours after the handling of infested

sheep. Since the sheep tick remains upon the animal during its entire life cycle it will be necessary in order to combat it to use some substance upon the animal that will kill the ticks and still not injure the sheep or its fleece.

Dipping or immersing the infested sheep in a liquid that will kill the ticks is the most practicable method known for eradication. The dips generally recommended for this purpose are those containing arsenic or nicotine as the active principle, and the coal-tar or cresylic acid dips. These dips are manufactured and sold for this purpose and care should be exercised to follow closely the directions supplied by the manufacturer. Under no consideration should one attempt to make and use a home-made arsenic dip without reliable instructions and guidance. One sheep owner attempted this and lost a considerable number of sheep out of his flock and nearly poisoned himself. If after following the directions closely the dip used does not eradicate the ticks, notify the Ohio Agricultural Experiment Station, Wooster, or the Federal Insecticide Board, Washington, D. C.

From 10 days to 2 weeks after shearing is generally considered the best time for dipping, as the shear cuts are then generally healed. It is dangerous to dip sheep in some of the dipping preparations if there are any fresh wounds upon the animals. However, sheep may be dipped at any other time during the summer or early fall if they are found to be infested. Even during the winter, according to some authorities, they may be dipped with reasonable safety if the dipping for the day is finished by noon so that the flock may have time to dry off and fill up with feed before night. Others state that dipping in the winter is too severe and should not be practiced.

The problem of safely and effectively combating the tick in winter is yet unsolved. Spotting, or pouring the liquid along the back and allowing it to run down into the wool is sometimes reserted to. This remedy, however, should not be considered as final, for at best it kills only a few of the ticks. The infested flock will have to be dipped in the spring. The use of an insecticide powder suggests itself since this form of treatment has been very effective against external parasites upon other animals

During the winter of 1917 the Ohio Experiment Station conducted an experiment to test the effectiveness of pyrethum and the Cornell (Lawry) powder as a remedy for ticks. The powder was applied by means of a shaker made by punching holes in the lid of a tin can. The wool was spread apart by the person holding the

sheep while an assistant handled the shaker. It took about 10 minutes to dust one sheep. Each sheep was thoroughly dusted on head, neck, back, rump, legs and abdomen.

TABLE II.—DATA AND RESULTS OF THE DUSTING

Sheep number	Powder used	Ticks before dusting	Live ticks 7 days after dusting	
		Dozen	Adults	Young
163	Cornell (Lawry)	3	1	0
169	Cornell (Lawry)	1+	1	2
168	Cornell (Lawry)	6	1	0
175	Cornell (Lawry)	3	0	0
165	Pyrethrum	1	0	0
172*	Pyrethrum	1	6*	.....
173	Pyrethrum	2	0	0
176	Pyrethrum	6	0	0
164†	Pyrethrum	3+	0†	0
166	Pyrethrum	1	0	0

*A very close-wooled animal.
†Some of the pupae gathered from this animal hatched out in from 10 to 14 days.

It will be noted that pyrethum seemed to be more effective than the Cornell (Lawry) powder. However, neither one killed all the ticks and a second and perhaps a third dusting would be necessary to get those that escaped or hatched out after the first dusting. Dusting sheep is a tedious operation and could hardly be attempted except upon a small flock. And even then dipping should be resorted to in spring to eradicate those that escaped.

The feeding of sulphur to animals to rid them of their external parasites is often recommended by some well-meaning correspondent of the agricultural press. To test this method two lots each of 16 ewes, all tick-infested, were given free access to a mixture of 1 pound of sulphur and 2 pounds of salt. Each lot received 3 pounds of the mixture. In 2 weeks time they had consumed the mixture. An examination of the ewes revealed more ticks than before the test began. Fumigation gives promise of being an effective remedy for external parasites of animals and in time a practical method may be evolved for eradicating these pests by this means. It is interesting in this connection to note that soldiers suffering from itch or scabies found themselves cured after exposure to chlorine gas, which was largely employed by the Germans in gas attacks during the war.

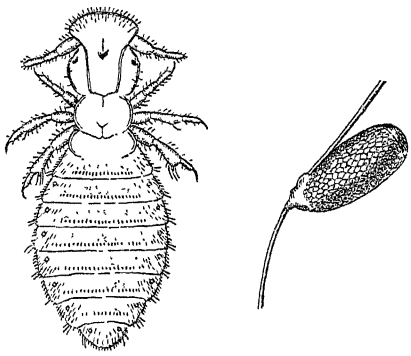
RED-HEADED SHEEP LOUSE

Trichodectes sphaerocephalus

Symptoms.—Lousy sheep may be observed rubbing themselves against the feed rack, posts, corners of the sheep pen or other stationary objects in order to relieve themselves of the itch-

ing sensation produced by lice. Frequently they scratch the infested parts with their hind feet or bite at the region infested. Not only do the bites and sharp claws of the lice annoy the sheep but they also affect the smooth pink skin. Animals heavily infested with these pests have a roughened dry skin covered with little dry brownish scabs. The wool fibers become loose, probably due to the cutting operations of the mandibles of the insects. Then by continued scratching and gnawing the infested sheep causes the wool to become ragged, short, dry, gnarly and worthless.

Description of Louse.—The little red-headed sheep louse is so small that it may easily escape detection. It is slightly longer than 1-25 of an inch. It is of a pale brownish color and possesses a reddish head. It commonly lives near the skin on the upper parts of the neck, shoulders, back and thigh, though it may be found on any part of the fleece. Coarse-wooled sheep seem to be more frequently infested. It is probable that sheep can only become infested by rubbing against other infested sheep or objects which these have rubbed against. No other host of this louse is as yet known. This louse was collected at Wooster, Ohio, November 24, 1917, and specimens have been received from Ft. Recovery, Ohio, taken November 21, 1917, and West Cairo, Ohio, January 8, 1917. The life history of this louse is similar to that of other lice. The tiny, pale, white "nits" are glued to the wool fibers. Young lice, similar except in size to the adults, emerge in a short time from the free ends of the "nits". The young shed their skin several times and finally reach maturity.



Sheep Louse, *Trichodectes sphaerocephalus*, adult and egg, greatly enlarged

Control measures.—The sheep louse may be effectively combated at the same time and with the same dips as are recommended for the sheep tick. In the winter, however, dipping is not advisable. Among the winter remedies that have been suggested may be mentioned fumigation and powder insecticide. Of the powder insecticides sodium fluorid gives the most promise. Sodium fluorid is a salt belonging to the same group as sodium chloride or table salt. It has recently been demonstrated by Bishopp of the Bureau of Entomology to be 100 percent efficient in combating

chicken lice. Prior to this work its only known insecticidal use was against cockroaches, for which it has been demonstrated to be highly effective.

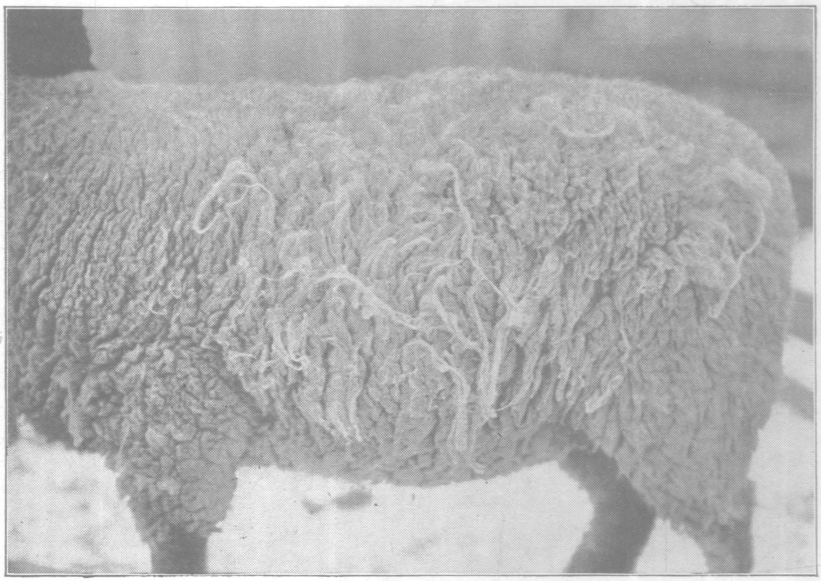
In December, the flockmaster at the Ohio Agricultural Experiment Station reported that the ewes were rubbing themselves and pulling out their wool. An examination of the taggiest of the ewes showed a heavy infestation of red-headed lice to be the cause of the unrest. As these ewes had been dipped 2 years before, the lice probably had been introduced into the flock by an imported ram. The importance of using protective measures in the case of every new addition from outside sources in therefore emphasized.

Dusting a sheep with a plunger gun.

There were 102 ewes in the flock. To treat each of them with powder seemed an endless operation. However, it was necessary to check the ravages of the lice. So sodium fluorid was tested on a

small scale, using three of the ewes most heavily infested. On two of these the powder was blown into the wool near the skin. On the one, the powder was dusted over the surface of the wool. As sodium fluorid is a heavy salt it was thought the powder would settle into the wool. A later examination showed that this method was not effective.

The trial test, however, proved satisfactory. So the entire flock of 104 ewes was treated. It was not possible to treat all of them in 1 day but the work was done on separate days whenever the time could be spared. Two men were required for the operation, one to hold the animal and spread open the wool, the other to operate the powder gun.



Ewe infested with lice

Two types of hand powder guns were used in the test. One was of the ordinary barrel and plunger type; the other, the rotating fan type. The latter type makes considerable noise which tends to frighten the animals. The intermittent operation of the rotary fan generally necessary in dusting a sheep was not conducive to a uniform dust spray when this type of gun was used. The ordinary barrel and plunger gun gave the most efficient service.

The time factor is an important point in the treatment for external parasites. When everything is in readiness the treatment of sheep parasites by dipping requires only about 2 minutes per

animal. Therefore dusting is not as expeditious as is dipping; however, after a little experience the sheep can be dusted at the rate of one in every 10 to 15 minutes. This can be readily accomplished if the man opening the wool moves his hand along with sufficient rapidity to maintain a constant operation of the gun and a uniform spray of dust.

The amount of material used is another important item and materially effects the cost of the operation. In the treatment of the 104 ewes only 5 pounds of sodium fluorid was used. At this rate it would take only about six-tenths of an ounce to one sheep. Thus at 50 cents per pound (the price paid for the material) the expense for the salt would average less than 2 cents per sheep.

Louse in sheep's wool.

While the statement cannot be made that one dusting with sodium fluorid is a completely effective remedy for sheep lice, yet the salt may be used in winter to check their ravages until warmer weather when sheep may be safely dipped. Two days after the sheep were treated we found a half-dozen lice on a few of the sheep examined. Bishopp states that the action of sodium fluorid when applied in dust form on poultry is comparatively slow, hence if an examination is made the day following or even 2 or 3 days later, some lice may be found; but the action of the powder persists, and after 4 or 5 days all lice disappear. However complete extermina-

tion of lice did not result from this test. Twenty-five days after treatment seven lice were found on three out of fifteen sheep examined. On most of the fifteen many dead lice were found.

Sodium fluorid appears to be very destructive to lice without producing any ill effects upon the host animals. No skin irritation or injury to the condition of the wool was observed. In dusting there was occasionally some temporary irritation of the air passages, as evidenced by sneezing.

It is said that if some of the sodium fluorid in the dust form reaches the body of the operator and if allowed to remain for a number of hours, as might be the case in dusting many animals, local irritation and burning may occur on tender portions of the skin. This effect was not experienced by the writer nor helpers. No special precaution was taken, but winter clothing and extra overalls may have afforded the necessary protection. During the operation some dust floats in the air which causes irritation of the throat and nose of the operator. This, although it caused considerable sneezing, proved only an incidental inconvenience. It may be prevented by keeping pieces of wet cloth over the nostrils and mouth, or by the use of a dust guard.

Summary.—Dipping with an effective liquid parasiticide is the most satisfactory remedy for external parasites.

Dipping is not advisable in the winter.

Powder insecticides give promise of being satisfactory for winter use.

Sodium fluorid was used in a test conducted at the Ohio Agricultural Experiment Station; 104 sheep were used in the test. The powder was blown into the wool by means of a hand powder gun.

The barrel and plunger type of powder gun proved the more satisfactory. From 10 to 15 minutes was required to treat each sheep using about six-tenths of an ounce of powder to each animal treated.

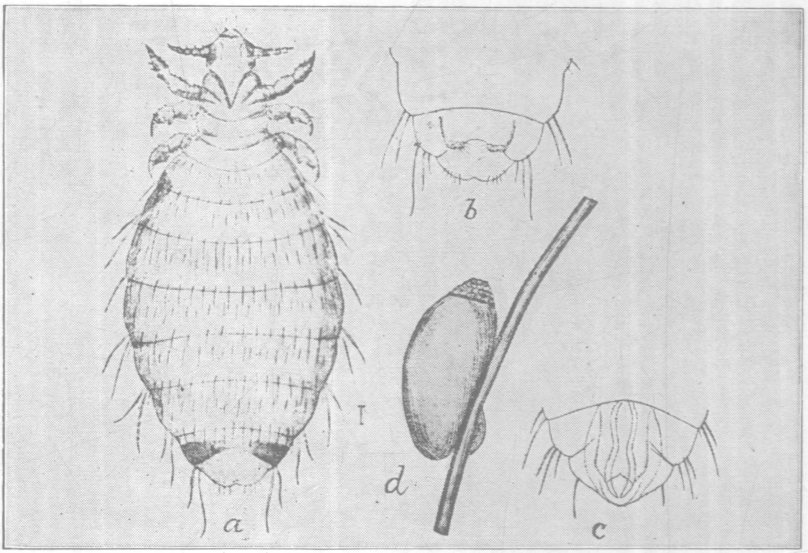
Sodium fluorid kills the lice without producing a detrimental effect upon host animals or operator.

SHEEP FOOT LOUSE

Haematopinus pedalis Osborn

Injury.—This louse differs from the other lice of sheep and goats in size, shape and character of the mouth parts. The latter are adapted for piercing the skin and sucking the blood of the host animal; hence, should the lice occur in abundance upon an animal, the injury no doubt would be more severe than that due to lice that do not puncture the skin.

Description of Louse.—The louse has about the same general shape as the short-nosed ox louse, though it is scarcely as broad and is slightly smaller. The darker portions of the body being more restricted give it a more immature look than the cattle louse. Professor Herbert Osborn first found this louse attacking the legs of sheep at Ames, Iowa, in 1896. So far as all examinations indicate this louse confines its operations to the legs and feet below where the wool is found. It is especially common to the region of the "dew claws" where the eggs appear to be most commonly deposited. These are attached to the hair near the skin. This louse has since been recorded from Virginia and Colorado. As yet, no specimens have been taken in Ohio.



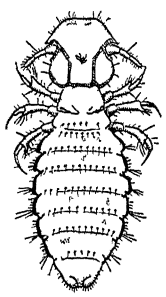
Sheep foot louse—after Osborn. Bul. 5, Division of Entomology, U. S. D. A. *Haematopinus pedalis: a,* adult female; *b,* ventral view of terminal segments of same, showing brushes; *c,* terminal segments of male; *d,* egg,—all enlarged.

Control.—The restricted distribution of this pest upon the host animal should make it an easy matter to treat the parasite at any season of the year. The feet and legs can be washed with any of the effective dipping solutions, or the sheep may be driven into a shallow vat containing enough of the solution to reach up to the body without wetting the wool. Dipping at shearing time for "keds" or ticks and biting lice will destroy this blood-sucking louse also.

GOAT LICE*

Symptoms.—These lice are said to be found more commonly upon goats than the red-headed louse is found upon sheep. They produce a pruritis causing the infested animal to scratch and rub itself which action aids in producing a scabby skin and loss of fleece. A heavily-infested animal lacks energy and finally becomes poor and thin.

Description of Louse.—Two species of biting lice are found upon goats, both of which are commonly referred to as goat lice. The common goat louse (see name) appears to be the more abundant. This species was collected at Wooster, Ohio, from an Angora goat on June 14, 1914. This louse commonly resides among the coarse hairs along the back and sides. It is slightly longer than one-twenty-fifth of an inch, with brownish head and thorax, pale yellow abdomen with dark lateral bands and median spot on each segment. The head is more of a quadrangular shape than is that of the red-headed sheep louse. The Angora goat louse no doubt appears in Ohio but no specimens have been collected, or received by the Ohio Station.



Goat Louse, *Trichodectes climax*

Control.—The lice may be combated by dipping or by the use of an insecticide powder (see control of sheep lice), or by use of an ointment applied to the infested parts. Dipping is the most effective means of combating these lice.

COMMON SCAB MITE

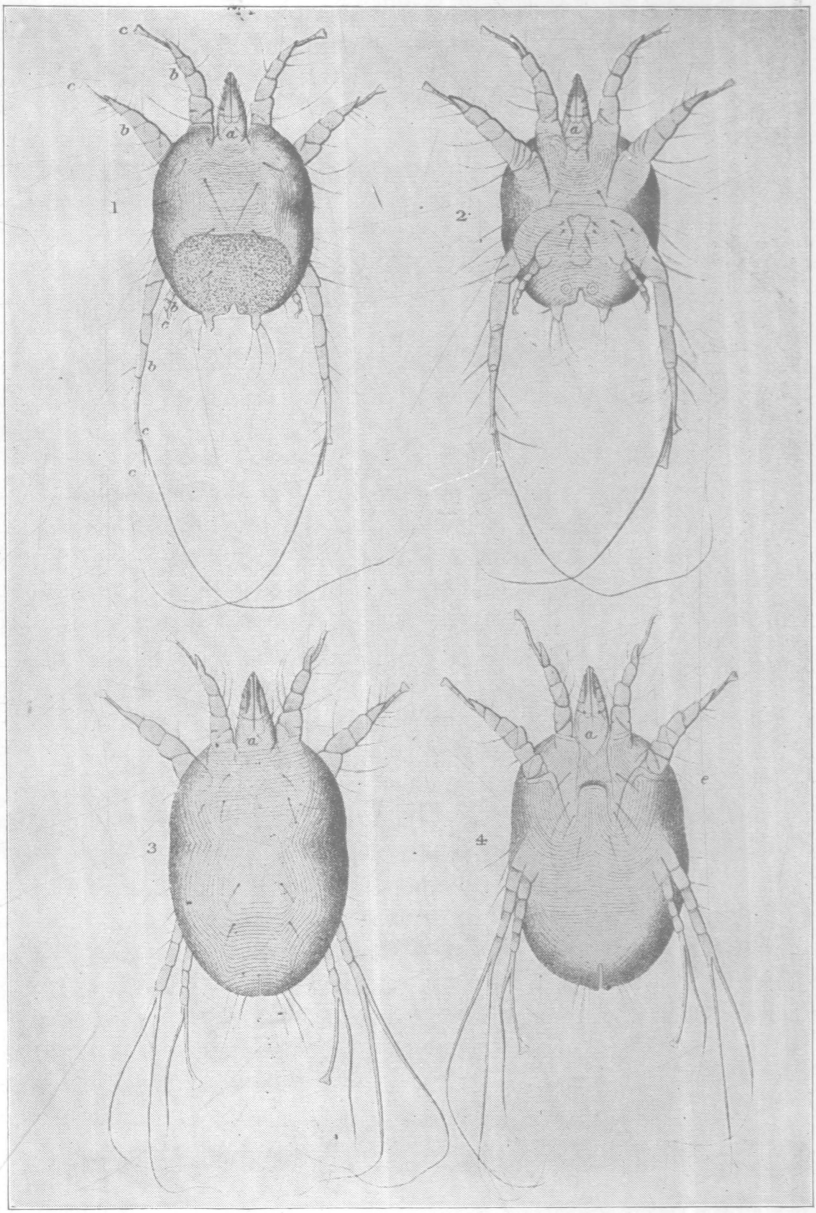
Psoroptes communis var ovis

Symptoms.—This parasite is one of the most widely advertised of sheep parasites by reason of the vigorous efforts of the Federal and State Governments to eradicate it.

The mites are readily transmitted from one sheep to another. This may be done by contact with an infested sheep, by racks against which it has rubbed or from tags of wool, pastures or other places where a host animal may have been. The mites seem to multiply and spread more rapidly in the colder months of the year.

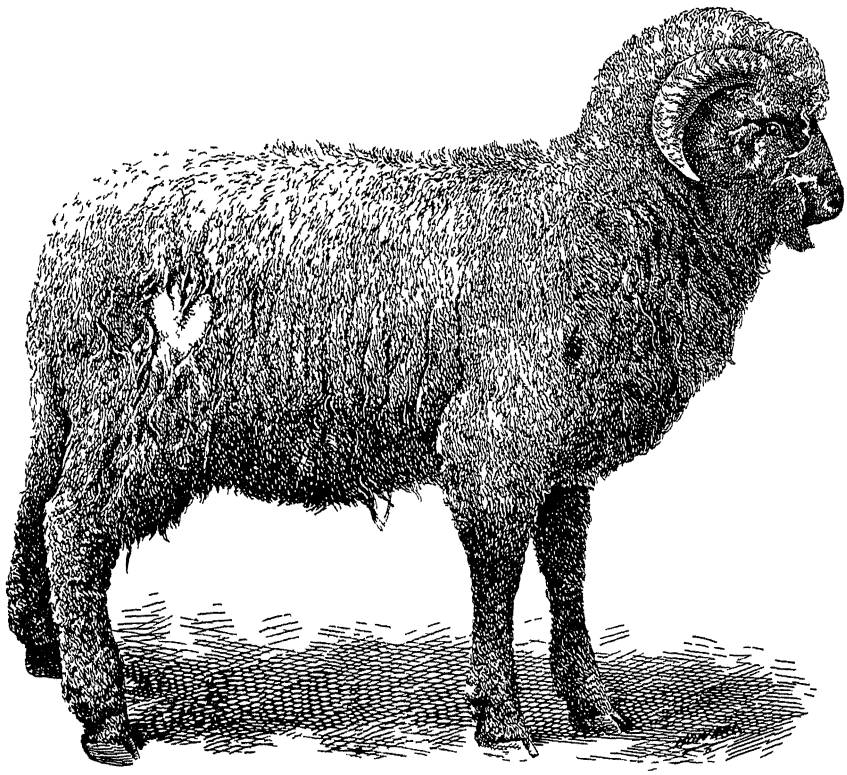
The tiny mites, once introduced into the wool, prick the skin and apparently introduce some irritating substances, for an itching sensation soon manifests itself. The sheep bite at the infested region, scratch it with their hind feet or against some stationary object. The skin becomes inflamed or reddened and small pimples

*Trichodectes climax (common goat louse). *Trichodectes limbatus (Angora goat louse) *These lice do not seem to be found on sheep but are noticed here because the goat is not an uncommon animal in Ohio.



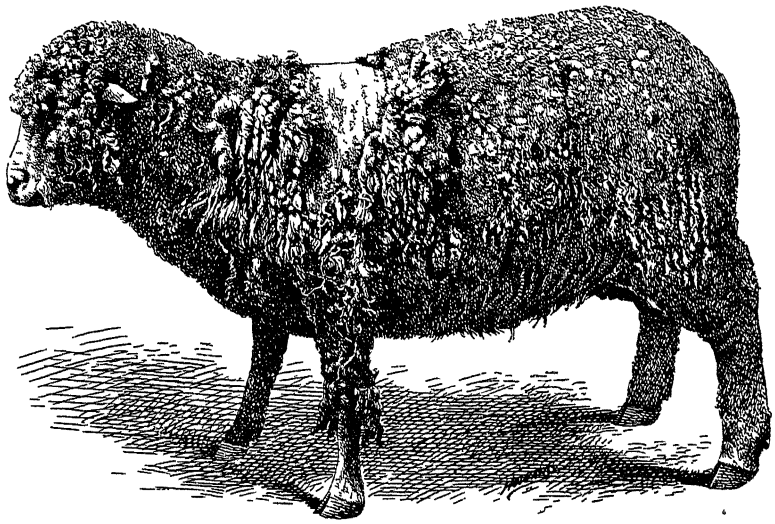
Life stages of the common scab mite

are formed. As the mites multiply the area of the infested regions increases and the itching becomes more and more aggravating. The pimples break and serum oozes to the surface of the skin. This material becomes mixed with the natural secretions and dirt and soon hardens into crusts or scabs. The skin in the infested areas becomes hard and thick. This may be readily detected by pinching up a portion and comparing it with the surrounding healthy skin. Constant biting, rubbing and scratching of the infested region soon causes the fleece to assume a condition commonly known as "broken". It becomes discolored, worn and ragged. Large areas of the skin become entirely denuded of wool as shown on page 74. Unless properly treated the disease may spread over the entire body, the sheep becoming more and more debilitated until it finally succumbs. Only a few have been known to recover spontaneously.



A slightly advanced case of common scab.
From Bul. No. 21, Bureau of Animal Industry, U. S. D. A.

Description of Mite.—The mites although small—the male may attain a length of one-fortieth of an inch, the female one-thirty-fifth of an inch—are readily visible to the naked eye of an experienced observer. They may be found on any part of the body covered by the wool, but are most commonly found where the wool is thickest. According to Gerlach, the female deposits its eggs in clumps of the skin at the base of the wool fibers. Each female generally deposits not less than fifteen eggs, which hatch after an incubation of 3 or 4 days. The young mites grow to maturity in 7 or 8 days and in 3 or 4 days more mate and start the cycle over again.

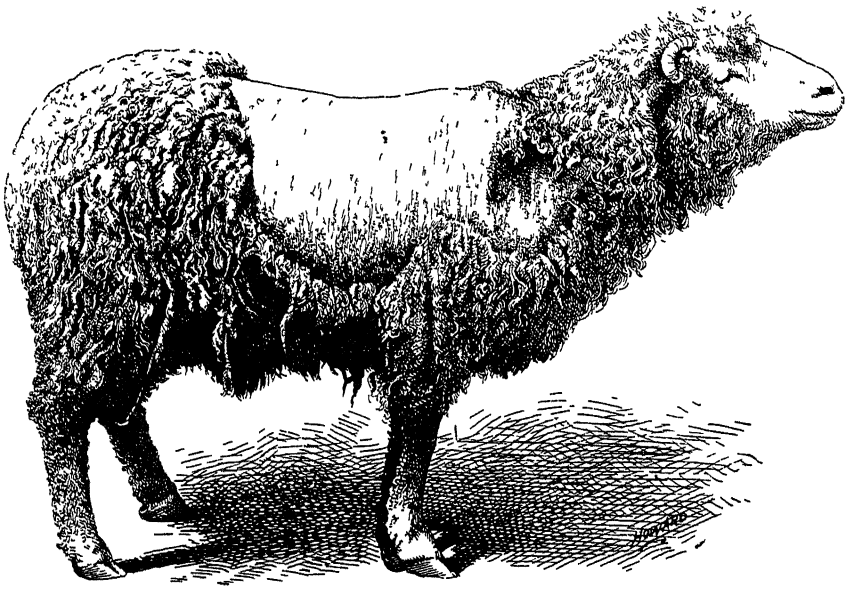


A more advanced case of common scab.
From Bul. No. 21, Bureau of Animal Industry, U. S. D. A.

Control.—Certain points in the life history of the scab mite have an important bearing upon the method of combating this parasite. The complete destruction of the scab mites is necessary in order to cure the disease that they produce. The eggs of the scab mite seem to be especially tenacious. It is, therefore, necessary to dip a second time after the eggs have hatched, but before the young have become sufficiently mature to deposit eggs again. From the data on the life history, 10 to 14 days after the first dipping has been determined as the best time for the second dipping.

The vitality of the scab mite when separated from the host animal is also of practical importance. Since the mites and eggs may be scattered here and there in sheds, or pastures, on tags of wool and loosened scabs, it is necessary to know how long they will

live under these conditions in order to make recommendations concerning the use of such sheds and pastures. Various authorities place the length of life of the mites when removed from the body of the host at from 2 weeks to as many months. Pastures may be safely occupied at an earlier date than buildings and pens. Two months may safely free open pasture, but it is thought that a much longer time should elapse before healthy sheep are introduced into once-infested buildings. In fact, the safest plan consists in a removal of all the bedding and loose material of the sheds to land that is to be plowed and thoroughly spraying the walls, floors and racks with a slightly stronger solution of the dip than is used on the sheep.

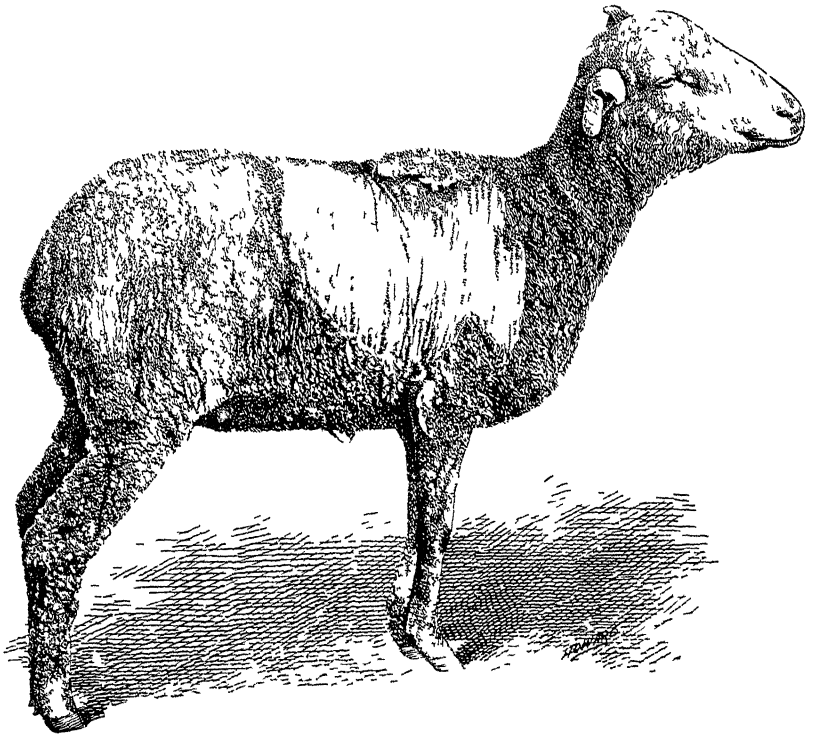


An advanced case of common scab.
From Bul. No. 21, Bureau of Animal Industry, U. S. D. A.

HEAD SCAB MITE

Symptoms.—This tiny mite confines its attacks almost exclusively to the parts which are not covered with wool. Its presence is usually first observed on the lips, in the vicinity of the angles of the mouth and on the edges of the nasal openings; more rarely it may show itself first around the eyes and ears. The mites penetrating into the skin cause little watery pimples to arise at the point of attack. The itching appears to be intense, for the animals rub the infested portions vigorously against the rack, on

the ground, on their fore legs or against other sheep. The small pimples break and a watery fluid runs out which on drying forms a small crust. Repeated scratching aids in spreading the infection and increasing the inflamation. The little brownish-yellow scabs in time become larger, thicker and may even cover the entire face if treatment is not applied.



A shorn sheep with large bare area due to scab.
From Bul. No. 21, Bureau of Animal Industry, U. S. D. A.

Description of mites.—All stages of this parasite, eggs, young and adult males and females, may be found in the moist layer underneath the scabs. The adults are just visible to the naked eye of the trained observer, being about 220 to 440 micromillimeters long. The minute, oval egg is deposited by the female in the burrows which she makes by means of her mandibles. One female as she progresses in her burrow may leave behind her a row of from 10 to 40 eggs. The young, on hatching, spread to healthy tissue, beginning burrows of their own. Thus the mites spread the infestation over the face and to other sheep, should the infested sheep come in contact with healthy animals. This mite has been known

to attack goats, dogs and in rare cases, man. There is also a variety of mite closely resembling the head scab mite of sheep which commonly attacks goats. This latter variety has been found to attack sheep, cattle, horses, swine and even man.

Control.—In the early stages of the infection an application of any of the dips recommended for common sheep scab may be applied directly to the infested parts. However, after the formation of the crusts, it is advisable to soften them by the use of oil or grease, and later to remove the scabs through the use of water and alkali soap. Then apply any one of the following:—the lime and sulphur dip, the tobacco dip, oil of cade, or Helmerich pomade which is made as follows:—

Sublime or precipitated sulphur	10 grams
Potassium carbonate	5 grams
Vaseline	40 grams

FOOT SCAB MITE

Symptoms.—This mite confines its attacks to the feet and limbs. The mites spread very slowly from the first point of attack, commonly the hind fetlocks, and ascend little by little the upper part of the legs, rarely passing beyond the thighs. In infections of long standing, however, they may invade the inner sides of the thighs, the udder and the scrotum and in rare cases the front legs. Early in the infestation the skin becomes inflamed and covered with fine small scales, and later with yellowish white crusts. The infested animals stamp their feet, scratch and gnaw at the infested parts which action aids in producing sores and scabs. As the mites multiply the yellowish-white crusts increase and become thicker, and a later stage is reached in which the skin cracks.

Description of Mites.—Under the crusts the parasites may be found in abundance, but in order to readily detect them a magnifying glass is necessary, for the mite only measures 310 to 400 micromillimeters by 250 to 260 micromillimeters. The mite lays its eggs under the crusts. These may hatch in a short time into immature forms which shed their skin several times before reaching maturity.

Control.—The mites appear to spread very slowly, both from infested regions to healthy tissue and to other animals in the flock. In an infested flock, only 2 to 3 percent of the sheep are attacked. The remedies proposed for common sheep scab mite may be used to combat the foot scab mite.

DIPPING SHEEP

By far the most effective method of combating external pests of sheep consists in immersing the infested sheep in watery mixtures which will kill the parasites. Immersing sheep in a reliable

sheep dip, properly mixed and intelligently handled, is cheap, quick and effective and is the method in general use in this country.

The dip used and the methods of applying it vary in different parts of the country. For small flocks, a tub or vat large enough to hold a sufficient amount of the solution to completely immerse the sheep, may be used. The required amount of water may be heated in one or two capacious kettles. Where hundreds of sheep are to be treated, especially prepared dipping pens, vats and draining pens and large boilers for heating the water are necessary.

Effective dips contain certain ingredients which are poisonous to the parasite. These ingredients may also, if used in too concentrated a solution, be poisonous to the sheep. But this danger may be avoided by preparing the dip as directed by the manufacturer and maintaining the recommended strength throughout the dipping operations. In addition to the poisonous constituent, the dip may contain other elements, as water to dilute and dissolve the poison; also such substances as alum or potash to make the poison more readily soluble or miscible with water.

The chief poisons used in the various dips are tobacco, arsenic, sulphur and lime, coal-tar oils and cresylic acid. Any one of the dips containing these poisons, when correctly made, intelligently diluted and properly applied, is effective. Each has its advantages and disadvantages. For scab, lime-sulphur, tobacco and arsenic dips are usually recommended. For lice and the so-called sheep ticks, tobacco, coal-tar creosote and cresylic acid dips are commonly recommended.

COAL-TAR CREOSOTE DIPS

The coal-tar creosote dips appear on the market under a bewildering number of trade names. They are made from coal-tar derivatives. Creosote oil is the name given to the principal ingredient. This oil is made soluble or miscible in water by means of soap.

Chemists of the U. S. Department of Agriculture have determined that in order to be effective, these dips should contain, when diluted and ready for use, not less than 1 percent by weight of coal-tar oils and cresylic acid combined. In no case should the diluted dip contain more than four-tenths of 1 percent nor less than one-tenth of 1 percent of the cresylic acid; but when the proportion of cresylic acid falls below two-tenths of 1 percent, the coal-tar oils should be increased sufficiently to bring the total of the coal-tar and the cresylic acid in the diluted dip up to 1.2 percent by weight.

Lack of a practical field test for determining the extent of deterioration of the coal-tar creosote dips makes the task of re-

plenishing the dip in the vat largely a matter of guesswork. In order to obtain a homogeneous solution of the diluted dip, it is necessary to use soft water, and to be sure that the undiluted dip is homogeneous in character (before using it) as occasionally, especially in cold weather, a separation of the coal-tar oils and other constituents of the dip may occur.

CRESOL DIPS

The cresol dips are made of cresylic acid and soap and are sold under various trade names. The term cresylic acid is usually applied to those cresols and phenols, derived from coal-tar, which boil between 185 degrees C. (365 degrees F.) and 250 degrees C. (482 degrees F.). To be effective, these dips should when diluted contain one-half of 1 percent of cresylic acid. At present there is no field test for the cresol dips so that renewal in the vat is, as with the coal-tar creosote dips, largely a matter of guess work.

Soft water is essential to the effectiveness of these dips. In fact it is advisable to test the water that is to be used in order to avoid injury to the animals. This may be done by first thoroughly mixing a small portion of the dip with water in a bottle in the proportions recommended for dipping. After an interval of an hour if oil globules appear at the top or bottom of the solution then the water is unfit for use.

NICOTINE DIPS

Nicotine dips are sold under various trade names. In using this type of dip, as with all other commercial dips, the directions of the manufacturers should be followed. By means of a field test designed by one of the large manufacturers the percentage of nicotine may be ascertained at any time during the dipping operations.

LIME-SULPHUR DIPS

The home-boiled lime-sulphur dip is made in the following proportions:

Lime, unslacked	8 pounds
Or lime, commercial hydrated	11 pounds
Flowers of sulphur	24 pounds
Water	100 gallons

The lime and the sulphur and about 30 gallons of water are boiled together for 1 hour or until all the sulphur disappears from the surface of the liquid. This is done in a kettle over fire or in a barrel or other suitable tank by means of steam. The dip should be siphoned or poured off carefully, and strained, then diluted to 100 gallons and is then ready for use. It is necessary that sufficient lime be used to properly "cut" the sulphur. On the other hand an excess of lime in the dip will tend to injure the sheep and wool.